

What is claimed is:

1. A rotary union, comprising:
 - a housing having a fluid path through which a fluid can be conveyed through the
 - 5 housing;
 - a rotor having a fluid path through which a fluid can be conveyed through the rotor, wherein the rotor is rotatably coupled to the housing;
 - a post having a fluid path through which a fluid can be conveyed through the post, said post being positioned in the rotary union in a manner effective to help fluidly couple
 - 10 the rotor fluid path and the housing fluid path such that a fluid can be transferred between the housing and the rotor via the post fluid path; and
 - an annular gap surrounding at least a portion of the post, wherein the annular gap constitutes at least a portion of a drain pathway through which a portion of fluid conveyed through the housing fluid path is drained from the rotary union.
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2. The rotary union of claim 1, further comprising at least one bearing interposed between a portion of the rotor exterior and a portion of the housing interior.
3. The rotary union of claim 2, wherein the at least one bearing comprises:
 - 20 ball bearings made with material comprising ceramic material; and
 - inner and outer races made with material comprising hardened stainless steel.
4. The rotary union of claim 2, wherein the at least one bearing is un-lubricated.
- 25 5. A rotary union, comprising:
 - a housing having a base portion;
 - a rotor having a first end positioned at least partially in the housing interior, wherein the rotor is rotatably coupled to the housing;
 - a post that extends from the base portion of the housing at least partially into a
 - 30 chamber in the rotor, said chamber being oversized relative to the post such that an annular gap extends along a length of the post between the post and the rotor;

a first fluid port associated with the housing through which a fluid can exit or enter the rotary union;

a second fluid port associated with the rotor through which a fluid can exit or enter the rotary union;

5 a fluid pathway extending through the rotary union at least between the first and second fluid ports, said fluid pathway comprising first and second pathway portions, wherein the first pathway portion extends through the post, the second pathway portion extends through the rotor, and wherein the first pathway portion is in fluid communication with the second pathway portion via a juncture inside the rotor chamber;
10 and

 a drain pathway having an inlet inside the rotor chamber proximal to said juncture, wherein the annular gap between the post and the rotor constitutes at least a portion of the drain pathway.

15 6. The rotary union of claim 5, further comprising at least one bearing interposed between a portion of the rotor exterior and a portion of the housing interior.

 7. The rotary union of claim 6, wherein the at least one bearing comprises:
 ball bearings made with material comprising ceramic material; and
20 inner and outer races made with material comprising hardened stainless steel.

 8. The rotary union of claim 6, wherein the at least one bearing is un-lubricated.

 9. The rotary union of claim 6, comprising at least two bearings interposed between
25 a portion of the rotor exterior and a portion of the housing interior.

 10. The rotary union of claim 5, wherein the post exterior side region has one or more surface discontinuity.

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11. A fluid delivery system comprising the rotary union of claim 5, comprising:
a source of fluid, wherein the first fluid port is fluidly coupled to the source of fluid; and
a rotating point of use, wherein the second fluid port is fluidly coupled to the
5 rotating point of use.
12. A method of using the rotary union of claim 5, comprising:
fluidly coupling the first fluid port to a source of process fluid;
fluidly coupling the second fluid port to a rotational point of use; and
10 transferring process fluid from the source of process fluid to the rotating point of use.
13. A rotary union, comprising:
a housing;
15 a rotor having a first end positioned at least partially in the housing interior,
wherein the rotor is rotatably coupled to the housing;
a post that extends from the first end of the rotor at least partially into a chamber in the housing, said chamber being oversized relative to the post such that an annular gap extends along a length of the post between the post and the housing;
20 a first fluid port associated with the housing through which a fluid can exit or enter the rotary union;
a second fluid port associated with the rotor through which a fluid can exit or enter the rotary union;
a fluid pathway extending through the rotary union at least between the first and
25 second fluid ports, said fluid pathway comprising first and second pathway portions, wherein the first pathway portion extends through the housing, the second pathway portion extends through the post, and wherein the first pathway portion is in fluid communication with the second pathway portion via a juncture inside the housing chamber; and

a drain pathway having an inlet inside the housing chamber proximal to said juncture, wherein the annular gap between the post and the housing constitutes at least a portion of the drain pathway.

5 14. The rotary union of claim 13, further comprising at least one bearing interposed between a portion of the rotor exterior and a portion of the housing interior.

15. The rotary union of claim 14, wherein the at least one bearing comprises:
ball bearings made with material comprising ceramic material; and
10 inner and outer races made with material comprising hardened stainless steel.

16. A method of making a rotary union comprising:
providing:

15 a housing having a fluid path through which a fluid can be conveyed through the housing;

a rotor having a fluid path through which a fluid can be conveyed through the rotor;

a post having a fluid path through which a fluid can be conveyed through the post;

20 at least one bearing;

positioning the post in the rotary union in a manner effective to help fluidly couple the rotor fluid path and the housing fluid path such that a fluid can be transferred between the housing and the rotor via the post fluid path;

25 rotatably coupling the rotor to the housing such that an annular gap surrounds at least a portion of the post, wherein the annular gap constitutes at least a portion of a drain pathway through which a portion of fluid conveyed through the housing fluid path is drained from the rotary union.

17. The method of claim 16, wherein rotatably coupling the rotor to the housing
30 comprises interposing at least one bearing between a portion of the rotor exterior and a portion of the housing interior.

18. The method of claim 17, wherein the at least one bearing comprises:
ball bearings made with material comprising ceramic material; and
inner and outer races made with material comprising hardened stainless steel.

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19. The method of claim 17, wherein the at least one bearing is un-lubricated.

20. The rotary union of claim 17, comprising at least two bearings interposed between
a portion of the rotor exterior and a portion of the housing interior.

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